AMERICAN
RAILROAD JOURNAL,
AND
MECHANICS' MAGAZINE.

No. 11, Vol. VIII. New Series.] JUNE 1, 1842. [Whole No. 407. Vol. XIV.

[For the American Railroad Journal and Mechanics' Magazine.]

DURATION OF RAILWAY BARS.

In the March number of the Journal of the Franklin Institute is a description by Mr. Latrobe, of the new track, 96 miles, between Harpers Ferry and Cumberland on the Baltimore and Ohio railroad, to which Mr. Ellwood Morris, has appended certain remarks, which it would seem were more intended to bring his favorite *cast iron bars* into favor, than to do justice to the more approved and tried qualities of the *rolled iron bar*.

The following extract is in the form of a note, and as it contains the pith of his remarks, is sufficient to enable us to show that he has been too hasty in making up his mind on this important subject.

"Time was, when Engineers generally, were under the impression that rolled iron edge rails of 50 pounds to the yard, would last from 40 to 60 years, but experience is fast dissipating all such ideas, by demonstrating that the duration of rails of malleable iron is not determined by mere superficial wear, but, *by the time which it requires for a given trade rolling upon them, to dis rupt the bars into their elementary lamina*; and the present indications of experience are, that upon railways possessing an amount of trade, equal to that which annually traverses the railroad between Philadelphia and Columbia, rolled iron edge rails of the T and H forms and of ordinary dimensions, will not endure more than ten years.

"That the public authorities of our State are becoming aware of the probability of this, may be inferred from the following

extract taken from the late report on the condition of the Columbia railroad, made to the canal commissioners of Pennsylvania, by W. B. Hufnagle, Esq., the Engineer in charge of that work during the past year.

"'One fact, (says Mr. Hufnagle) however, cannot be concealed, that the iron rail which forms the heaviest item in the construction of a railway, exhibits strong symptoms of coming destruction, and even now, a portion should be replaced with new iron of an improved pattern;—the laminæ of which it is composed appear to have become detached, and exfoliate under the pressure of the cars, thereby requiring the rail to be reversed, or rendered useless,—this reversion has so frequently taken place that prudence would dictate the importation of at least 50 tons to supply the defective parts.'

"Here is a striking verification of the prediction made many years ago concerning rails of malleable iron, by W. Chapman, of Newcastle, a distinguished English Engineer, (see Wood on railroads) whose opinions were then strenuously combated by other engineers, who must now, or soon, admit, that Mr. Chapman's anticipations *were truly prophetic.*"

It would seem unaccountable how any Engineer, fairly entitled to be so called, can refer to the experience and results on the Columbia road, when it is so generally allowed that in no one particular has that illfated road had any chance of vindicating the merits of this invaluable improvement.—It has been a real school of experience, but in having been able to do so much under its many disadvantages, tells favorably for the value of others which have profited by its lessons, and are operating under the absence of most or all of the causes which have made it a failure; yet how seldom is any distinction made.

Mr. Morris ought certainly to have asked himself in the first instance, what might have been the quality of this particular rail on the Columbia road, manufactured near the infancy of the art, before proceeding to make general conclusions from it, such as that the T or H form of rail would be destroyed in 10 years by the passage over it of 1,500,000 tons. The following remarks taken from an article in the December number of this Journal, on the "manufacture of iron for railways," in England, will show the importance there attached to this subject, and, although much has been done, there is yet room for further improvement.

"A considerable portion of the evil arises from the fact, that, with

some very few exceptions, neither the directors nor the engineers of railways, are practically acquainted with the manufacture of iron, and are therefore not aware of the immense difference which exists in the quality.

"One great evil attendant on the employment of iron of inferior quality, arises from the circumstance, that iron exposed to great and sudden changes of temperature, and to a constant percussive action is liable to a *slow and gradual* change arising from a re-arrangement of the particles among each other.

"The two great distinguishing features of wrought iron are known by the names of *cold short-iron and red short-iron*, the former being the toughest when hot, and the latter when cold—the cause of this great difference is still involved in mystery. We may imagine, therefore, that if any similarity exists between the two cases, that in possessing a *tendency to the cold short quality* will, when subject to the constant state of vibration to which it is exposed on railways, more rapidly deteriorate than *red short iron*, and become more crystalline in its texture, and therefore possess less cohesive strength.

"But, whatever may be the tendency to deterioration, there is far too little attention paid to procuring, in the first instance, iron which has been manufactured by processes likely to secure an approved quality.

"Now, the result of all this is, that the finished rails, instead of being of a tough fibrous texture, are only one remove from cast-iron in quality. Thousands, nay tens of thousands of tons of rails have been made and are now making in this way, and the directors and engineers are alike ignorant both of the practice and of the very serious results, to which it may lead.

"There are, however, other causes which determine the quality of iron, not less than the different process of manufacture. The minerals of some districts are naturally so weak that no art or care in the manufacture can render the iron made from them sufficiently strong for any description of railway work. The very general introduction of the hot blast has tended much to deteriorate the strength of pig iron."

It is thus seen how much depends on the original quality of the bar—and that the slow and gradual deterioration (like the poison in tea) arising from the percussive action of the trade rolling over it, is only somewhat quickened by a tendency to the *cold short*

quality;—at any rate, the progress to decay of the ordinary rolled bar, from this cause, is quite inconsiderable.

The real cause, however, of all the mischief is in the hammering effect of the locomotive, and the slipping of its drivers in certain states of the weather—and this will be in a *double compound* ratio over a neglected track, such as that of the Columbia road. But Mr. Morris does not distinguish between this destructive action and the comparatively harmless one of the mere rolling friction of the car—and we are sorry to find Mr. Hufnagle, the engineer of the Columbia road doing the same, as is seen in the above extract from his report, in which he attributes the exfoliation of the rail to the *pressure of the cars*,—when it is notorious to the merest tyro, that this is caused altogether in the first instance, by the locomotive, and mostly in the shorter curves. This evil is scarcely felt in England where they have few curves, or if any of immense radii.

It is very evident that Mr. Hufgnale in his said report, has given an undue importance to this matter of exfoliation by his expression, that "symptons of *coming* destruction" are seen in it, which has alarmed Mr. Morris for the whole track—who overlooks that Mr. Hufnagle himself in that very extract, had proved its insignificance by asking for only 50 tons to replace the destruction from this cause, after seven to eight years of *abuse* of the road—a demand equal to only 7 tons per ann., or $350: but allowing it to be 50 tons per ann, at $50 per ton, it is only $2,500, which on an average of only 100 miles of track, being mostly double, only requires at that rate of wear, the small item of $25 per mile per ann, to renew the whole of it, and which would be *nearly refunded by the sale of the old iron.* The really expensive item about a railway is therefore the labor of adjusting and levelling the track, amounting fully to the whole cost of the renewals, and the two together on a good road ought not to exceed 6 to $700 per mile per annum.

Mr. Morris estimates the amount of tonnage which has passed over the Columbia road in the last seven years at 1,300,000 tons in cars and locomotives, which, he says, has reduced the rails to their present *dilapidated condition*; and hence infers that two millions of tons would be sufficient to crush off the top tables of the rails and to render them entirely useless. He has, however, in allowing 3 tons to a car, only given the weight of the car—in which on an average there is a loading of $2\frac{1}{2}$ tons—this added to his estimate will make up the tonnage to two millions as already passed over the road, and by which it should now be accordingly destroyed; but

which Mr. Hufnagle disproves by asking for only 50 tons to replace the destruction in 6 to 7 years out of nearly 7,000 tons; so that neither Mr. W. Chapman of Newcastle, England, nor Mr. Ellwood Morris of Philadelphia are likely to be considered the prophets they would be, in this matter of the speedy destruction of the rolled malleable bars. We have another and competent witness to bring on the stand against the assertion of the present *dilapidated condition* of the rails on *even* the Columbia railroad.

Mr. Sano, for many years an engine-driver, afterwards for a long time foreman to Mr. Morris' locomotive manufactory, and lastly in charge of the repair-shop of this very Columbia railway for the past 14 months, thus conversant with the properties of iron, asserts that the rail is in the main as good now as the day it was laid down; and this he considers the more wonderful, as the iron was never of the best sort—the rail is of the inferior T form, feebly supported on slight cross ties with a chair at each, the whole forming a ricketty track—the weight of the rail also being inadequate to the various locomotives which have been run on it at times by the most unskilful and careless enginemen. Recently there have been laid 28 miles new track with a heavier rail of the H form; and the effect on passing to it with the locomotive from the old T track, he describes as similar to the passage of a common carriage from a stone pavement to a wooden one; and hence, may be inferred, the immense saving in both road and machinery, when the rail is firm and rigid, and the track in good adjustment. He has no faith in being able to use the *cast-iron bar* with locomotive power, owing to the difficulty of casting a bar of any length with a uniform temper—the effect of the locomotive, particularly when its drivers slip, being to tear and blister the surface very soon, making of it a succession of hills and dales. This action is seen on the cast-iron switches; and near the Columbia Bridge there are some cast-iron sidings affected in this way, the locomotive passing over them once only to ten times over the rolled iron bars alongside of them, which continue unharmed. With horse power the cast-iron bar will continue to be found serviceable for lateral roads.

Over the Mine Hill railroad with a rolled iron bar of 35 lbs. per yard using horse power, there have been passed about one million of tons of cars and coal, and this rail is as good as it ever was; but in anticipation of connecting with the main stem to Philadelphia, and using locomotives, it has been replaced by a heavier rail of 62 pounds per yard. By the report of the Camden and Amboy road; after 8 years at the points most used, the rail is declared to be per-

fectly sound; and the evidence is abundant enough both here and in England, that for an approved form of H rail,* thirty years of useful duration, is a fair term without limit of trade, during which period, a small allowance of $40 to $50 per mile per annum, at the present cost of iron, will pay for its gradual renewal, or rather for the difference between the old and new iron, including the expense of relaying.

It is not now of much consequence to know what it cost to lay a track at the prices of 1836 and 1837, a period of the highest inflation of the currency—it is at present on an everage 33 per cent. lower, and the new track superstructure of the Baltimore and Ohio road cannot cost over $8,000 per mile, in place of near $11,000 as made by Mr. Morris—the B ridge form of rail or U pattern, adopted for this road, is deemed preferable to the H form by many experienced judges, but as yet it has not been long enough in use to determine its superiority over the later forms of H rail. The price of railroad iron delivered in this *country is* now about $42 per ton.

A false dread of the early destruction of the rail, very soon after it gets into use is almost universal; nor is this surprising, when the many imperfections in the earlier structures are considered, but now that these have been mainly remedied of late, and further improvements are every day being made, all true friends of the cause should do their best to convince the public of this important fact. But all such efforts will be in vain, if the *idle hearsay*, from which the mass take their impressions, as interest dictates, is to receive *apparent* confirmation, because presented to them in works of authority, the contributors to which are supposed, as professors, to have investigated and to understand the subject on which they treat.

In conclusion it is not risking much to assert, before those who have studied this subject practically, that the improvement in quality and form of bar, in more firmness of track generally, a more equal destribution and greater effect of the weight or adhesion of the locomotive, stronger cars, and a more moderate speed for freight—these with more skilful management in minor details, all combine to produce for the future on the railway, the creation of only yesterday,

*There are now on the Philadelphia and Pottsville line of railway, three different formed sections of rail of the H pattern—one of 45, one of 52 and one of 62 pounds per yard. the latter on the mine hill branch. That of 52 pounds was intended as an improvement on the one of 45 pounds and was said in England to present the best possible distribution of its weight for strength, and we believe it would be considered quite as strong as that of the 62 pounds, on which the additional 10 pounds per yard appear wasted in an unnecessarily wide base.

far less wear and tear, and have reduced it down to a ratio on the receipts, which ensures a reasonable dividend on all such as connect desirable points. Wear and tear must always exist—it has been gradually and will be yet further reduced on the railway, but at even the present *average ratio* of 35 to 40 per cent. which allows for its *entire renewal*, the good derived from it relatively to that to be obtained from any other improvement, perhaps nominally less expensive, must hereafter secure it a preference of adoption in a large majority of cases.

The following article from the Chronicle and Sentinel of Augusta, has been examined and commented up by Mr. J. E. Bloomfield at our request. It will be perceived that the statistics of *four* out of the *seven* roads in the table have been copied exactly from our Journal without any notice of acknowledgement of the source whence they are drawn. We are most happy to acknowledge the labors of the gentleman who has prepared the table as far as the addition is concerned, and every such addition is a new element in our views of railway science. But it is no more than fair to acknowledge that the plan of table is that prepared for several years expresly for this Journal by our friend Mr. Joseph E. Bloomfield and recommended by him as a model for this purpose. We are glad to find new laborers in the cause, but must protest against making use of our labors, who as pioneers have borne the heat and burden of the day, while those who come in at the eleventh hour obtain the penny we cannot get.

We insert the table as we find it for the purpose of comparison, and hope that the hint may be improved upon, and finally, that all the railroads in the country may have their yearly statements tabulated in a similar manner, and with the improvements suggested.

"RAILROADS.

"We are indebted to a gentleman of this city, who takes a lively interest in whatever relates to railroads, for the following condensed tabular statement of the cost, receipts, expenses, nett profits, etc., of several roads, which enables the reader, at a glance, to compare the relative value and management of each. This exhibit is highly flattering to the Georgia railroad, but we are quite sure not more so than is due, for we are confident there is no road in the Union, in the building and management of which a more rigid economy has been practised."

Comparative view of the cost, receipts, expenses, and nett profits, of the following railroad companies, for the year ending during the winter and spring of **1842**, *as shown by their last report.*

Name of Road.	Length.	Expended in cost of road & machinery.	Cost of road per mile.	Repairs of engines and cars.	Repair of road.	Repairs of road per mile per year	Fuel, oil, salaries & incidental expenses.	Total expenses.	Total receipts.	Income from passengers.	Income from freight & mail.	Dividend per annum.	No. miles run by engin's during year.	Cost per mile run by engin's exclusive of interest on capital.	Total expense per mile of road per year.
Boston and Lowell.	25¼	1,834,193	71,290	22,644	33,193	1,200	63,631	119,469	267,541	145,953	121,588	8	125,300	81¼cts.	4,640
Boston and Providence.	41	1,782,000	43,460	12,722	24,474	597	84,857	122,057	230,821	152,015	78,806	7	107,638	93	2,977
Boston and Worcester.	44½	2,374,547	53,360	27,584	34,900	784	100,514	162,998	310,807	190,097	110,000	7	175,000	93	3,660
Eastern.	60	2,267,000	43,000	17,820	31,117	520	94,381	154,958	299,574	257,734	41,840	6	191,900	81	2,580
Petersburg and Roanoke,	60	826,000	13,766	16,513	36,534	609	43,351	96,398	174,184	43,976	130,208	7			1,606
Charleston and Hamburg,	136	2,400,000	17,647	67,986	74,456	547	101,987	244,429	322,740	136,937	185,803	3½	253,560	96½	1,720
Georgia Railroad,	147	2,350,000	16,000	15,724	38,692	264	36,784	91,200	224,255	71,460	152,795	6	152,520	60	620

[For the American Railroad Journal, and Mechanics' Magazine.]

I have examined, at your request the article made up for the Augusta Chronicle and Sentinel, of the 12th Inst., by a gentleman of that City, and am gratified to find that the tables prepared for your Journal for the last four years, from the Official Reports of Massachusetts, have been serviceable to the Railway cause, by a comparison of receipts, expenses, repairs, fuel, etc.

The good management of the Georgia railroad is as creditable to its directors, as the ill success of the Charleston and Hamburg railroad shows some decided defects, if we compare the proportion of *Receipts*, with the *Expenses*. On the Georgia railroad, all the expenditures are $91,200, 41 per cent, to receive $224,255. On the Charleston and Hamburg railroad, the expenses are at the extravagant rate of $244,429, or 76 per cent, to receive $322,740. This requires explanation.

On the Petersburg and Roanoke railroads the Expenses, proportioned to the Receipts are about 55½ per cent., $96,398, to $174,184.

On the best conducted railroads in the state of New York, the ratio of expenses to receipts is about 33 per cent.

A principal item in the expenses of Southern and all roads, is certainly less than in the Northern railroads;—I allude to Fuel.—The comparison is very striking, as between the Boston and Worcester railroad 44¼ miles, and the Georgia of 147 miles, in the items under the heads of "fuel, oil, salaries and *incidental* expenses"—over the Boston and Worcester railroad 175,000 miles were run, for $162,998, or 93 cents a mile, exclusive of interest on the cost of the road.

Over the Georgia railroad, the distance run was 152,520 miles, for $91,200, or, at the exceedingly low rate of 60 cents per mile.

The saving appears to be in "*fuel*, oil, and incidental expenses."

On the Boston and Worcester railroad, these items are placed at $100,514; on the Georgia, at $36,784. This discrepancy is stated in remarks on the table alluded to [page 172, vol. 8, No. 6] of your Journal, to arise from the necessity the Boston and Worcester railroad was under to submit to "a change and improvement in the line of their road, and *Depots* to meet the heavy freighting business this railroad must be prepared for, since the completion of the Albany, West Stockbridge and Western railroad to the outlet of the Erie canal." The track has been doubled 20 miles. The principal freight depot covers an area of 56,000, feet. Items strikingly applicable to working the railroads ought only to be admitted.

Taxes, accidents, and new works should be separated, or, it is impossible to arrive at correct conclusions.

It should be further noted, that the Boston and Lowell railroad, with a heavy edge rail, has a double track. It is equal to 51 miles of the Georgia railroad, therefore, the total expenses per mile should be placed at $2,320 per mile instead of $4,640 per mile, by the author of the table. In making comparisons, a still further deduction in the road of $14,638, or above $600 per mile, should be made, for taking up 7 miles of the track laid with 36 lb. rail, and replacing it by rail of 56 lb. to the yard. This is noticed by the report, but not by the editor of the Georgia paper.

The Boston and Providence, and the Boston and Worcester railroad are partially double.

It would have added much to the value of the table if the weight of the iron per yard,—if flat, or, of the edge or T form had been given, and the expenses of working the road, kept separate from the repairs to engines and these again separate from the repairs to the cars. It would, perhaps have accounted for the great difference in the comparative expenses on the three southern railroads inserted in conformity to the plan prepared for your valuable Journal, from the very meagre reports, made to the Massachussetts Legislature.

The table may be much improved, and railroad Companies are invited to contribute to this useful class of information, for the benefit of stock holders.

J. E. B.

[For the American Railroad Journal and Mechanics' Magazine.]

The following Memorial from *the New-York and Erie Railroad Company*, to the legislature of the State of New-York of this year, it may be well to preserve for future reference, as the day may come when the state will be unwilling to own that it had once refused to continue its aid to this great and useful work. We trust sincerely it has only been made a temporary sacrifice to the malign influence of politics, aided by the jealousy of the canal interest, and more particularly that of the Delaware and Hudson Canal, which although joining in the cry against railways as suited to the carriage of heavy freight, were yet considerably alarmed lest this road be allowed to connect with the same coal region, which is now solely dependent on them for an outlet to market. This, coupled with the necessity for muzzling the railways along side of the Erie canal, should arouse the people of the State to deliver themselves from

being thus canal-ridden, and imitating the other more enlightened portion of our own country, and the general practice at present in Europe, to turn their attention more to railways as the best suited to give the greatest elasticity to trade.

Russia is about undertaking a work of equal magnitude to the New-York and Erie railway—the project being to connect St. Petersbugh with Moscow, a distance of about 470 miles. She has sought among our engineers for a superintendent of this splendid enterprize, and her enlightened Emperor sees clearly enough that his empire now extended and weak, will be made, by a judicious management of this improvement, compact and strong. In short, as a matter of self-defence, the different states of Europe are now *fortifying* themselves with railways, which operate not by the destructive discharge of bullets, but by the beneficent spread of social feeling and of industrious habits.

"MEMORIAL IN FAVOR OF THE NEW YORK AND ERIE RAILROAD.

"We, the undersigned citizens, residing on and near the route of the New-York and Erie railroad, unite in this memorial without distinction of party: and after a full and deliberate reflection upon the present financial condition of the State, and of the public works unfinished and in progress.

"It is not our design to discuss, or avow an opinion upon the controverted question as to the ability of the state to make large appropriations for rapid progress in those works, or her policy touching that question. Our object is to declare, in plain and unequivocal terms, our opinion of the just rights and claims of the southern and southwestern counties, collectively—and as contrasted with other portions of the State—having particular reference to the Erie canal, and the New-York and Erie railroad.

"We have always doubted the policy of the Erie canal enlargement. We believe that if the original canal had been improved, by clearing its bed and doubling its locks, and the State had adopted and made the New-York and Erie railroad—we should have had every required facility to secure the trade of the west—while the convenience and prosperity of our citizens would have been more widely diffused and promoted. Different counsels have, however, prevailed. The state is already deeply committed in the enlargement; while the railroad is left mainly to the doubtful efforts and results of private enterprize. But the most mortifying and ob-

jectionable feature in this policy is yet to be stated. Vast sums of money, have been already expended on this enlargement, which has furnished the principal ground for alarm and proposed taxation.

"The millions already spent have been, and the millions yet to be required will, doubtless, be demanded and obtained as a matter of course, and almost without discussion, upon the plea, that the canal is a State work, and the State must provide for its own. While, on the other hand, our Legislature refuses to adopt the railroad—and then, hesitates in extending aid because it belongs to a private company! Such an apology for exhausting all the resources of the State upon the line of the Erie canal, is regarded by us as neither satisfactory nor admissible. We can regard no legislation as either equal or just which does not respect alike all sections of the State. It is not our fault that the New York and Erie railroad has not been adopted by the State. And, in truth, we deem it of little moment, in reference to our own claims for State aid, who owns the road, provided the laws secure to us fair and equal privileges in its use and accommodations. We want the road not for its tolls and direct profits—but to settle our new lands—give a quickening impulse to every department of industry and enterprise among us—and to afford those aids and conveniences to our citizens at large, which they cannot otherwise enjoy.

"Again—it cannot be expected that the railroad in question can be completed by unaided private enterprize; and we consider that our citizens have full right to claim that if the unfinished works on the canal shall progress, provisions shall also be made for the continuation of the work on the railroad. If appropriations to the canal are urged on the grounds of preventing waste in unfinished constructions, or in materials already provided, with equal force may such a claim be made in behalf of the railroad. On its almost entire line are a half constructed railway, many unfinished bridges culverts, and a vast amount of timber exposed to deterioration or utter waste, half completed contracts, the suspension of which would, in numerous instances, ruin the contractors; and, in short, we allege that even a suspension on the work for a single season would produce, almost throughout the line, deep pecuniary embarrassment, and no little absolute distress. On every great work of this kind, whether controlled by the State or individuals, the interests of the whole community within its influence, become so involved and intertwined, as to render it mainly public in its character and results. And in respect to the railroad in question, it is in fact

peculiarly public property by the liberal portions of stock which have been taken by citizens on its extended lines—not with a view to pecuniary profit, but to aid in its construction.

"The citizens of the southwestern counties are doubtless as truly patriotic, and as zealous for the general welfare as those of any portion of the State, and would as cheerfully submit to a sacrifice of local interest when the necessity of the State shall demand it. If the exigencies of the State demand an entire suspension of the works in progress—or, if appropriations must only be reduced—or, if active progress may be prudently made, when sustained by by reasonable taxation—we doubt not that our citizens would cheerfully yield to any required correspondent legislation. But we can never consent that the State shall refuse either to adopt or lend its needful aid to the completion of the New York and Erie railroad, while it lavishes all its disposable resources on other portions of the State, more powerful to enforce demands, or more favored in their importunities.

"In making these declarations, and avowing *our settled determination to maintain them in every constitutional way in our power*, we disclaim every intention to countenance or uphold any improvident appropriation or wasteful expenditure of public money, and we desire to see in every law making such appropriations, every precaution and safeguard against extravagance.

"In conclusion, we remark, that if it shall be deemed by a majority of your body, most for the interest of the State, to suspend for a season the usual annual appropriations of stocks for the prosecution of public improvements—we, nevertheless, believe that some legislative aid may be rendered to the New York and Erie railroad, which will neither increase State stocks, nor very materially enhance State liabilities. Such an object will, as we believe, be attained by passing the bill recently introduced by Mr. Faulkner, a Senator from the sixth district. And such being our belief, we unite in our request for the passage of that bill.

March, 1842.

"HOT AIR BLAST."—IMPORTANT TRIAL.

J. R. Neilson the well known inventor of the Hot air blast, has commenced suits against many of the iron companies using his Patent without permission. Some technicalities it seems prevented him from obtaining the benefit his invention entitles him to recieve.

At a recent trial however in Glasgow, a Jury found in his favor,

and in such a manner as to leave no room for further difficulty. The damages were assessed at £3060 sterling, at the rate of 11*l.* 16*s.* per ton for all the iron smelted since the plan of Mr. Neilson has been adopted

---

We take pleasure in making known the following Report of the Committee of the Franklin Institute on Messrs. Baldwin and Vail's new locomotive engine.

Some time since, our readers may recollect, we gave an account of this engine and its improved advantages.

BALDWIN AND VAIL'S LOCOMOTIVE ENGINE.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a six wheeled, geared, Locomotive Engine, intended for the transportation of heavy freight trains, manufactured by Messrs. Baldwin and Vail, of Philadelphia, Pennsylvania, Report:—

That the sub-committee appointed to examine the above mentioned engine, met upon the Columbia railroad on the 25th of January, 1842, and went with the engine out to the Schuylkill bridge, and returned with it to Broad street, drawing a train of burthen cars, the gross load being about 200 tons, which was much below the limit of the engine's power, but included all the cars that were then ready to be brought in.

The peculiarity of this engine consists in its obtaining the adhesion of the four wheels of the truck, in addition to that of the main driving wheels, without preventing the truck from vibrating so as to accommodate itself to the curves and undulations of the road. Experience upon the American roads, as far as known to this committee, proves that engines having six wheels and provided with leading trucks, move much more steadily than those with only four, and, as a partial loss of power and other injurious consequences result from the slipping of the driving wheels of locomotives, (which often occurs to a considerable extent, even when it does not prevent the engine from drawing its load, and is not noticed by the engine-man) it is very desirable to obtain the adhesion of all the wheels, without losing the advantages of a vibrating truck.

The difficulty in doing this arises from the fact, that when the engine stands on a curve, the axles of the truck wheels are not parallel to that of the main driving wheels. Messrs. Baldwin and Vail obviate the difficulty in the following manner. A pair of main driving wheels, forty-four inches in diameter, are placed behind the fire-box, as in their well-known form of engine, but the axle, instead of being cranked, is straight, and the connecting rods from the pistons of the cylinders have outside connections; and

attached to the same wrists are other connecting rods, extending forward and giving motion to a shaft under the front part of the boiler and between the axles of the truck, which shaft is secured so as to maintain its parallelism with the axle of the main driving-wheels, at right angles to the axis of the boiler. On the middle of this shaft a cog wheel is fixed, having chilled cogs slightly rounded on the face, which, by means of two intervening wheels, give motion to others on the axles of the truck. The four truck-wheels are thirty-three inches in diameter, and the gearing is proportioned so as to make them travel at the rate of the larger wheels.

The steam cylinders are thirteen inches in diameter and sixteen inches stroke. The gross weight of the engine in running order is 29,980 pounds, which is apportioned so that 11,755 pounds, are on the two points of contact with the road behind the fire-box, and 18,225 pounds on the four points of contact under the truck. When tried upon the Columbia railroad in the presence of the committee, the engine drew its train readily around curves of 757 feet radius, the rounded surfaces of the chilled cog gearing allowing the axles of the truck to suit themselves to the curvature of the track. The engine passed with ease around a curve of ninety degrees, having a radius of 312 feet, the train being detached, and afterwards backed itself around a curve of seventy-five feet radius without difficulty.

The engine has since been in use upon the Reading railroad, and it appears from a certificate of Mr. Nicolls, the Superintendent, that on the 12th of February, it drew from Reading to the Columbia railroad, a distance of fifty-four miles, a train of 117 loaded freight-cars; the cars weighing 215, and the freight 375 tons, making a gross load of 590 tons. The speed when in motion being ten miles per hour.

In the opinion of the committee, this engine combines in a high degree the advantages of a vibrating truck with the use of the adhesion of all the wheels; they think it well worthy of the attention of railroad companies doing a freighting business, and believe that it will add to the deservedly high reputation of the builders.

By order of the Committee,

WILLIAM HAMILTON, *Actuary.*

February 21st, 1842.

CORROSION OF IRON IN STEAM BOILERS AND STOVE PIPES.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the Corrosion of Iron in Steam Boilers and Stove Pipes, where Anthracite is employed as fuel, Report:—

That they have gathered such information as lay in their power from those who have witnessed the corrosive action, and combined it with their own observations.

It appears that stove-pipes are frequently corroded in the course of a year or two, where they are not taken down or cleansed subsequent to their employment through the winter season. An instance is known in which forty feet of pipe were corroded and rendered a perfect colander in the course of two years. Nor does it appear always as a necessary condition that the place should be damp, although this is the case in a majority of instances, for in the corrosion just noticed, the proprietor stated that the stove was very dry. The corrosion rarely happens in an upright pipe, but usually in one lying horizontally, for where such corrosion had already commenced it was said, in one instance, to have been obviated by giving the pipe a slight inclination. Where it takes place in an upright pipe, it may arise from the flowing down of corroding matter from a horizontal layer of the same.

The same kind of corrosion is observable in steam boilers in which anthracite is employed as fuel, and not in those in which bituminous coal is used. That it does not arise from the intensity of the heat is shown from the fact, that it is greatest in the boiler-flues which lie horizontally at a distance from the fire. A corrosion is sometimes observed near the top of the smoke pipe in steamboats, but this may be attributed to the alternate action of heat, cold, air, and moisture.

It would appear then, that the corrosion is caused either by the vapors arising from the combustion of anthracite, or from matter carried up mechanically by the draft; or from both combined. That it does not proceed from uncondensable gaseous matter is proved by the occurrence of corrosion only when a stove-pipe is no longer exposed to these vapors, during the summer season, or where a boiler is cooled from intermitted fires. It does not arise from matter carried up mechanically, for this could only be ashes, and we know that the ashes of anthracite is of a dry nature; and without moisture, chemical action, or the corrosion, could not occur. It must, therefore, be produced from condensable vapors.

On examining the interior of a stove pipe lying horizontally, whether corroded or not, we find a loose ashy deposite of a greyish brown color; and where corrosion has taken place, the greater part is condensed into a solid mass,showing that it had absorbed water. Upon fracturing the solid material, smallwhite crystals appear under the microscope, which are generally too imperfect to admit of recognising their form. By subliming the mass, a little empyreumatic oil and water are formed, but the greater part sublimed is an ammoniacal salt. Upon testing a solution of the ashes, it shows a large content of muriate and sulphate of ammonia, the former evidently in much greater quantity than the sulphate. After complete sublimation at a red heat, the ashy matter remaining appears to be nearly pure charcoal or lamp black, with a mere trace of coal ashes. From the qualitative tests made, it would appear that the ammoniacal salts constitute at least three-fourths of the whole mass. A mere trace of iron was detected.

From this content of saline matter, as well as from its nature,

we are at no loss to account for the corrosion of iron where the air and moisture add their conjoint action; but it may be doubted whether the ashy matter has the power of absorbing moisture from an atmosphere of ordinary dryness, for in dry situations it appears that there is usually no corrosion, and in the case noticed at the commencement of the report, it may be doubted whether the stove was dry.

How to obviate the corrosive action is a more difficult point to determine, unless the very simple process be resorted to of cleaning out stove-pipes every spring, and boiler-flues every few weeks.

If the stove pipes are required to remain standing with the sediment in them, then a previous internal coating of white lead, litharge, or red lead might probably answer the best purpose, since it would result in the production of chloride and sulphate of lead; while the ammonia would be driven off. The thin coating of these salts of lead might then prevent the contact and the further action of the ashy deposite. Experiments made in the U. S. Mint during the winter of 40—41, seem to show that a coating of lime on the interior of a pipe prevents corrosion, and it is said that a few stove manufacturers in this city are acquainted with the fact. The committee, however, in the face of these facts, are rather inclined to believe that the oxide of lead will prove more efficient, since the sulphate of lead is a wholly inert salt, and the chloride nearly insoluble, while sulphate of lime is somewhat soluble, and the chloride of calcium very soluble and therefore likely to produce corrosive action eventually. Still the operation of whitewashing is the simplest mode of obviating corrosion, and may be repeated at intervals.

The content of chlorine to such an extent as is developed by the above chemical examination, is interesting in a geological point of view, since it has not hitherto been found in chemical examinations of anthracite.

Prof. H. D. Rogers, in 1836, pointed out the fact, that where heaps of refuse matter were burned near the coal mines, ammoniacal salts, and among them muriate of ammonia are sublimed, and may be found among the ashes. Now we know that saline waters are obtained from the coal measures in the western district of Pennsylvania, and moreover, it is the prevailing opinion among Geologists that the coal series are marine deposites; we can therefore explain the origin of the muriate of ammonia in the ashy deposite arising from the combustion of anthracite, by attributing the chlorine to the presence of a trace of chloride of sodium. (common salt) in the coal or its accompanying slate, or possibly in both. It is unnecessary to allude to the formation of ammonia, since it is a universal product to a greater or less extent of the dry distillation or combustion of every kind of coal.

The ammoniacal deposite is interesting in an economical point of view, since it accumulates in considerable quantity in a single season, and may be collected with facility. In one instance at least, ten pounds were removed from about eight to ten feet of pipe, which was the produce of three or four years, and hence, we may estimate

the large amount that might be obtained from many hundred pipes in Philadelphia every season. It may be employed either for the manufacture of salt ammoniac by a very simple process of sublimation with a small quantity of salt of lime, or it may be directly applied in powder or in solution to garden soils. The influence of ammoniacal salts in promoting luxuriant vegetation has been long known, but the admirable work of Professor Liebig on Agricultural Chemistry, has more completely developed their influence and importance. The material before us will unquestionably prove of great value to the gardener and florist, if properly applied to the soil; but it must not be forgotten that it is very rich in ammonia, and should therefore be employed sparingly.

By order of the Committee,

February 10th, 1842. WILLIAM HAMILTON, *Actuary.*

From the Civil Engineer and Architect's Journal.

MEMOIR ON THE PRACTICABILITY OF SHORTENING THE DURATION OF VOYAGES BY THE ADAPTATION OF AUXILIARY STEAM POWER TO SAILING VESSELS. *By* SAMUEL SEAWARD, *F. R. S., M. Inst. C. E. From the Transactions of the Institution of Civil Engineers.*

The fearful expense which has been found to attend the extension of steam navigation to voyages of extraordinary length appears to constitute an insuperable obstacle in the present state of the steam-engine to the beneficial establishment of lines of uninterrupted steam intercourse between distant continents. The imperfect success which has attended the developement of the several enterprises which had for their object the maintenance of a steam communication between Great Britain and New York, is a proof of the difficulties which wait upon the performance of long steam voyages, and furnishes a lesson which will not be readily forgotten by future speculators. The successive disappearance of the Sirius, Royal William, Liverpool, United States, British Queen, etc., from the, Atlantic station, proclaims with a voice as authoritative as that of a messenger from heaven, that the Atlantic enterprise has been a failure, and that a perseverance in its prosecution, *under the same circumstances* which drove those vessels from the field, can only add energy to ruin and flagrancy to guilt.

For several years past the project has been in contemplation to adapt steam power to sailing vessels, in such a manner that it may be used to discontinue at pleasure, and it is the object of the author of the work before us, to recommend the extended adoption of steam power in sailing ships, as being productive of the most prominent of the benefits which steam navigation confers, without entailing any serious expense for the maintainance of its operation. A good ship, when impelled by a favorable wind, will realize a velocity which few steam vessels are able to surpass, and it is only in calms, or when the wind is adverse, that the peculiar powers of

a steam vessel are productive of benefit. It becomes a question, then, whether it would not be advantageous to so adapt steam power to sailing ships as to be only used in calms, or in adverse circumstances of wind and water.

In order to form any comparative estimate of the benefits of this proposed application of steam power, it is necessary to refer to the circumstances which attend the voyages of sailing ships and of regular steamers upon the open sea. In some of the lines of intercommunication between distant countries, vessels are exposed to strong periodical winds or protracted calms, while other lines are distinguished by winds which sweep across the ocean in one direction for nearly the whole year. In calms such as those that prevail about the line, and by which vessels on the route to India are often for a long period detained, a small portion of steam power might be most beneficially employed in transporting the vessel from the region swept by the current of wind which flows from the pole towards the equator, into the locality of those land and sea breezes which enable the vessel to continue her voyage; but the same proportion of steam power would be perfectly unserviceable in propelling a properly rigged ship against a strong adverse wind. For such a service a proportion of power to tonnage similar to that observed in our fastest steamers in indispensable, and it is only therefore in voyages where calms are likely to be met with that adaptation of auxiliary steam power to sailing ships can be productive of benefit. Upon the superior economy of vessels supplied with auxiliary steam power, Mr. Seaward makes several very sensible observations:—

"A most material circumstance affecting the utility and economy of steam vessels of great power, is the space necessarily occupied by the engines and the supply of coals, which are found to require three-fourths of the whole area below deck, leaving only one quarter for the stowage of cargo; and that, owing to the great weight of the former, must principally consist of measurement goods. Thus the "President" and the "British Queen," although of 2000 tons register, have never been able to carry more than 500 tons of measurement goods as freight.

"From a due consideration of these features of the question, with respect to the expediency of employing large steam vessels (and it is believed that few practical men will dispute the facts by which they are developed,) it is evident that the attempt to perform voyages of lengthened duration by the power of steam alone must, in the present state of engineering science, be attended with an expense wholly disproportionate to the profits.

"The present state, therefore, of steam navigation is evidently altogether inadequate to meet the large and daily increasing demand of commerce; and in this respect, as far as maritime navigation (as contra-distinguished from river and coast navigation,) is concerned, steam must be considered to be in its infancy, for the communication by this means with our own or with foreign distant colonies—India, *via* the Cape of Good Hope—the West Indies—

the pacific Ocean—Australia—the Brazils, and other highly productive countries, is at present impracticable to any extent, as the facts hereafter stated will more distinctly show.

"Before entering upon the details of this scheme, either as regards its past success in the partial and limited application which it has hitherto received, or as to its future adaptation, it may be desirable to describe the class of sailing vessels to which auxiliary steam may be regarded as an applicable power, and where its employment may be expected to be attended with success; and here it must be observed, that commercial and not scientific success is the result looked to, for nothing can be considered succesful in a commercial point of view, to which a fair profit upon the capital employed does not attach."

The definition of the term "success" here given might be looked upon as unnecessary, had we not before us the rememberance of the strange perversion of the plainest language, during the discussion of the Atlantic steam enterprise. In that case success was regarded as synonymous with practicability.

Mr. Seaward informs us that auxiliary steam power is beneficially applicable to all vessels, from 400 tons upwards, and that the proportion of one horse power to 25 tons will propel a vessel in a calm at the rate of 5 knots per hour. He then institutes a comparison between the time occupied by the ship "Vernon," fitted with auxiliary steam power, on her voyage from London to Calcutta, and that of the steam ship "India' which performed the same voyage about the same period. The expenses attendant on the employment of auxilary steam power in the "Vernon" duriug this voyage are stated to have been £600; whilst the expenses attendant on the "India" for the same period are estimated at £4293, showing an excess of expenditure over that of the "Vernon" of £3693. The comparative rate of the vessels in point of speed, as stated by Mr. Seaward, appears by no means favorable to the "India;" but, as we know the "India" to have been detained for a considerable period at the Cape by stress of weather, and as we conceive there are evidences of some slight prejudice against the "India" in consequence, we presume, of her being a Clyde built vessel, we attach but little value to this part of the statement.

Mr. Seaward's memoir contains much important information, and manifests a familiar acquaintance with the subject of which he undertakes to speak, and the possession of a liberal share of good common sense. It is also well written, though we should have been better pleased with it had there been less straining after rhetorical decoration; a serious fault in any paper which professes to treat of practical and scientific subjects, especially when addressed, not to the herd of mechanical amateurs, or scientific cyphers, but to an association of able and practical men. Another fault which pervades the work, is the frequency of reference to and of involved commendation of, the Messrs. Seawards' engineering performances. We hear a great deal too much of the excellencies of the "Gem" and the "Ruby," and we find those vessels and the "Brunswick,"

the latter a work also of Messrs. Seaward's and a comparative failure, associated with and obtaining the precedency over the "Eclipse," the "Blackwall," and the "Railway," vessels by which, in point of speed, they are entirely outstripped. Such preferences as these manifest an unbecoming partiality, as ill-judged as it is impotent; and are equally unworthy of those by whom such communications are accredited as of those by whom they are rendered.

In conclusion, Mr. Seaward observes that he has avoided all recondite calculations, with a view of meeting more effectually the objects of practical men. He further informs us, that theoretical calculations upon such a subject as that he has undertaken to handle, however suited to the philosopher's study, are of little value to the practical engineer or ship builder; and he quotes the language of the late President of the Institution of Civil Engineers, to the effect that, what is wanted for that society is the developement of that knowlendge which is founded upon practical experience. From this intimation we might infer that, in the opinion of this gentleman, science is incapable of rendering any aid to the practical mechanist, but that he would be prepared to go into the most recondite computations, were such a course desirable. In reference to the first allegation, it is only necessary to observe that, in the developement of that knowledge which is founded upon practical experience, science is the most efficient instrument; in proof of which fact, we might refer to the extraordinary developement the arts have experienced since their progress has been aided by the light of science, as compared, with their station and condition when they were merely empirical. As regards the second implied allegation, namely, that Mr. Seaward would be prepared to enter into extremely recondite calculations respecting the subject of his memoir, except for the weighty reason he has given, we can only admire the discretion which dictated so much forbearance. If it be Mr. Seaward's desire to maintain his reputation for profundity, he will best accomplish his object by avoiding all attempted manifestation of it. The only attempt of this description in the memoir before us is in the 4th page, where we are told that "the employment of a quadruple amount of steam power would not double the speed, although in theory this is assumed to be the fact." By whose theory is this assumption made? We presume that it must be of Mr. Seaward's own fabrication, and his exclusive property, it being the theory of other engineers that the resistance increases as the square of the velocity, and the power necessary to overcome that resistance, as the cube of the velocity. And the reason is obvious. If the power be doubled, the resistance, is quadrupled; the force of the engine, therefore, to overcome this resistance, must be quadrupled also, and must act with a double speed. In other words, when the speed is doubled, the power requisite to maintain that speed has to be increased eight times instead of four times, as by the *theory* of Mr. Seaward.

[From the Civil Engineer and Architect's Journal.]

REPORT ON THE GAS FURNACES USED IN THE IRON WORKS OF WASSERALFINGEN, *By* M. H. SCHOENBERG.

ONE of the most important modern improvements in the manufacture of iron we owe to M. Fabre Dufaure, Mining Counsellor, Director of the iron works at Wasseralfingen in Wurtemburg, who has succeeded in collecting the gases which are formed in blast furnaces, which constitute the flame which escapes, and to use them in the refining, puddling and balling furnaces.

The use of the furnace flame for several purposes, as warming the air used for the blast, roasting lime and orc, making coke, and heating steam engine boilers, has been known these seven or eight years. It has not, bowever, been hitherto practicable to produce a higher temperature than red heat. which was a limit to its application; by M. F. Dufaures's process any degree of heat required can be obtained. The principal distinction of this method is the mode by which the gas is burned, by the introduction of atmospheric air supplied by bellows, and in the ingenious construction of the furnaces and fire-places.

At Wasseralfingnn there are now three furnaces worked by gas, but the refining furnace is supplied from the southern blast furnace alone, which is done by simply introducing a tube to a certain depth in the fire-place of the blast furnace. It appears that about a sixth or fifth of the gas evolved is collected by this method; and notwithstanding this substraction, no diminution is observed in the power of the flame which escapes. In the refining furnace there are thus produced 175 metrical quintals of fine metal, partly with a radiated crystallization, and partly with a ball-like structure, but all of a silver white. The gas refining is so complete, that the iron is produced highly decarburretted, and freed from all impurities among others, from phosphorus and sulphur. The waste which in common English refining is never less than trom 9 to 10 per cent., is not more here, when the furnace is in good order, than 1 to 2 per cent; and by this process a greater quantity of fine metal is obtained than if pig iron had been used. It is to be further observed, that the pig iron passed through the furnace here consists only of castings, which, as is well known, often contain a good deal of sand mixed with them.

The operation is so well arranged, and proceeds with such uniformity, that it rarely meets with those casualties common in the usual process of refining, while the cost of manual labour is also less.

The results of puddling by gas are not less satisfactory. The puddling furnace at Wasserelfingnn is supplied with gas from the northern blast furnace, into the fire-place of which are plunged two suction pipes, by which enough gas is collected, to work a puddling furnace and a refining furnace; but the power of the water-wheel which works the blast apparatus not being great enough, these works can only be supplied alternately. The temperature of the

puddling furnace is, from the nature of the process, higher than that of one fed with wood, coal, or turf; the flame also is clearer and transparent, so that the workman can easily watch the operation, and carry it on regularly. In each of these operations the furnace is charged with $1\frac{3}{4}$ or 2 metrical quintals of fine metal, previously heated to a red heat by another furnace; and at the end of an hour and three quarters, or two hours, the effect is produced.

The waste of fine metal in this process is very small, being only from 1 to 2 per cent. The quality of the iron is excellent. A feature peculiar to gas puddling is that the formation of slag and its reduction goes on spontaneously, so it is never thrown away. The produce of the puddling furnace is 125 metrical quintals per week.

The operation of refining in the gas furnace has, like the preceding, considerable advantages; but the results have not yet been so important as in the preceding cases, and the quantity of waste is still considerable. The draught of the furnace is good, and the temperature sufficiently raised; so that, unless an accident occur, the produce is 150 metrical quintals per week.

From what has been already said, it will be seen that the results of the gas furnaces at Wasseralfingen are most satisfactory. Even with castings and rubbish, bar iron of excellent quality is produced, with a waste of not more than from 12 to 15 per cent., and without the consumption of any costly fuel, or rather by making use of a combustible matter, which hitherto has not been turned to account,

Belgium is the only country in which M. Fabre Dufaure's process has not been introduced, while in other places it has been extensively used. In England, at Messrs. Hill's works, at Merthyr Tydvil; in Germany, at the iron works of the King of Bavaria, Grand Duke of Baden, Princes of Fustenburg and Sigmaringen, Duke of Anhalt, the Saxon Iron Company, Count Einsiedel in Prussia, &c.; in France, at Lucelle; in Hungary, at the works of Count Andreasky and M. Inglo; in Russia, at those of the Prince de Bukna and Count Malzon; in Sweden, at Mr. Ekmann's; and in Italy, at the works of Dorgo, on the Lago di Como.

At one of the meetings of the French Institute, M. Dumas read a letter from M. Grouvoelle, giving some further particulars not contained in M. Schoenberg's report, as to the process used by M. Fabre Dufaure in the iron works at Wasseralfingen. The practice is to carry into the refining furnace the pig iron delivered from the high furnaces, and not cold iron, as is usually done. The object is to save the caloric employed in the fusion. The puddling furnace produces 10,000 kilos, or about $9\frac{1}{2}$ tons of iron per week. At this time a third blast furnace is being constructed, and steam engines are being put up, to work the gas on a large scale. M. Fabre Dufaure's experiments began in 1837, and took place on refining cast iron; and the processes used by him at Wasseralfingen were kept secret until the present time, by desire of the King of Wurtemburg, who was unwilling that they should be known immediately in other countries.

After making this communication M. Dumas reminded the Aead-

emy that he had received about two months ago specimens of iron obtained in France by gas puddling in blast furnaces, by means of the process adopted at the iron works of Treveray, by the proprietors, Messrs. D'Andelarre and Lisa, and by the engineers, Messrs. Thomas and Laurens. He added, that the puddling furnace set up at Treveray has worked very well, and has already sent produce into market. In this furnace is refined iron, which is produced in the same way as in the common puddling furnace used in Champagne. The gas of a single blast furnace producing 5 cwt. of iron per day is enough to feed it; a result which proves that all the cast iron produced may be converted into bar without further fuel, while such a result cannot be deduced from the work at Wasseralfingen, where the quantity of iron produced even at present is much smaller than the quantity of cast iron afforded by the two blast furnaces at these works. M. Cumas states the advantage of the Treveray gas plan to be an improvement in the quality of the iron, which has the properties of charcoal iron, a considerable diminution of waste, and a great saving of fuel. It is to be further observed that no effect is produced on the blast of the furnaces from the shafts in which the gas is collected. M. Dumas remarked to the academy a passage in M. D'Andelare's letter, that the idea of using combustible gases for the same purposes as other fuel had been long since suggested by M. Thenard, in his public lectures; and the importance of these processes, which promise much, lies principally in the apparatus, which has enabled them to be successfully used.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.—INSTITUTION OF CIVIL ENGINEERS.

"*Description of a portion of the works of the Ulster Canal,*" *By* THOMAS CASEBOURNE, *M. Inst. C. E.*

The Ulster Canal, which is described in this communication, was designed for the purpose of facilitating the intercourse between the west and the north of Ireland. It commences at the southern extremity of Lough Erne, in the county of Fermenagh, whence it extends 46 miles, and enters the river Blackwater, near the village of Charlemont, in the county of Armagh, from which there is an outlet through Lough Neagh to the ports of Newry and Belfast. The total cost of this work will amount to about 210,000*l.*, or about 4,565*l.* per mile. Allusion is made to proposed junction canal between the rivers Boyle and Shannon, which may be considered as an extension of the Ulster Canal westward, effecting a junction between all the navigations of Ireland. By its means the produce of the town of Boyle, and the agricultural districts around it, would be conveyed directly by steam to Belfast and Newry. At the time of this communication, the Ulster Canal was rapidly advancing towards completion; it was navigable up to Clones, a distance of 40 miles from its commencement, and would be opened to Lough Erne during the summer of 1841. A description is given of the most diffi-

cult and expenisve portion of the canal, which is situated at about six miles along the line from Charlemont. The length of this part is about three-fourths of a mile, and it comprises seven locks. The expense of construction, exclusive of the value of land, was 17,053*l.* 4*s.* 9*d.*; in order to diminish the expense as much as possible, the canal was contacted in width in two points, where the local impediments were considerable. The transverse dimensions of the canal are, 19 ft. 6in. at the bottom, 36 ft. at the surface of the water, and and 42 ft. at the top bank—giving a slope of 3 ft. 2 in. at the sides of the channel. The depth of water is 5ft. 6 in. in all the reaches, except the summit level, which is capable of containing 7 ft. of water. The course of this portion of the line lay along the bottom of a steep ravine in a limestone rock, parallel with the channel of a millrace adjacent to the river Blackwater. The mill-race was, therefore, diverted into the river between the first and fifth locks of the canal. Between the third and fifth locks the bed of the canal was formed by blenching the rock on one side, and embanking on the other with the materials so obtained. Beyond this it was cut for a distance of nearly 350 yards through the limestone; in one place to a depth of 41 feet.

The sides and bed were then lined with puddle, and protected by a forcing of rubble wall. Thence to the seventh lock, the channel was again formed by benching and banking through a clay soil, where much caution was necessarily exercised in preventing slips at the foot of the embankment, which was subject to inundations from the Blackwater. The masonry was all constructed of limestone from an adjacent quarry. Two appendices are subjoined to this paper. The first of these gives in detail the items of expenditure for the portion of the canal described; the second contains a particular decription of the locks and lock-gates, the bridges, and the earth-work. The locks are 73 feet long, 12 ft. wide, and vary in rise from 6 to 11 feet. They are all constructed in ashlar masonry. —The paper is accompanied by three drawings, descriptive of the general plan and the details of these works, which were originally designed by Mr. Telford, and are now under the direction of Mr. Cubit. They have been executed almost entirely under the superintendence of the author.

An account of the Permanent Way of the Birmingham and Gloucester Railway. By G. B. W. Jackson, *Grad. Inst. C. E.*

The object of this railway is to afford a direct communication between the western and the midland counties of England. The communication describes the course of the line until it reaches Cheltenham, where it joins that which was formerly called the Great Western and Cheltenham Railway, which terminates at Gloucester.

Its length is 54 miles. The prevailing inclination is 1 in 300; but on the "Lickey" incline, near Bromsgrove, the rise is 1 in 37 for a distance of 2½ miles, in ascending which the trains are worked by American locomotives, in addition to the usual train engines. The northern portion of the railway appears to lie on the new red sand stone; then passes to the oolitic formation, on which it terminates.

In the former, the principal cuttings are through marl, some of which is exceedingly indurated and troublesome to work. The principal strata of the latter system are blue and yellow clays. Near Cheltenham, the shifting sand frequently necessitated the use of sheet piling in passing through it. The waters of Droitwich and Cheltenham were found to possess a saline quality, which rendered them unfit for the use of the engines. That from the surface sand near Cheltenham, however, is exceedingly good.

The building materials employed on this line were—the sandstone of the Lickey and Forest of Dean, the lias of Norton and Wadborough, and the oolites of Cheltenham and Bredon, together with brick, for which earth was readily procured throughout. The cuttings and embankments, with the details of the permanent way, are severally described. The surface width is 30 feet. In the formation of embankments and cuttings, the usual methods appear to have been adopted. In the former, the ratios of the slopes vary between 3 and 2½ to 1; in the latter, between 2 and 1½ to 1. In cuttings, there is a system of drainage beneath the ballast, consisting of longitudinal drains on either side of the line, connected by cross spits, all of which are filled up with broken stones The rails are supported by chairs and intermediate saddles, which rest on longitudinal balks; and these are bolted to transverse ties. On embankments whost height exceeds five feet, the cross spits, longitudinal balks, and saddles, are dispensed with. The length of the bearings, the weight, dimensions, etc., of the iron and wood work, with the manner of putting together the whole, are then noticed. The timber employed was American pine, and English beech, or larch. The various prices are enumerated of the materials and labor for the permanent way, of which the average cost per mile amounted to 5,430*l*. The present conditon of the line is stated to be good, and its general working to have been perfectly satisfactory, since its opening in June, 1840.

Subjoined is a description of an artificial ballast obtained by burning clay, which was employed when the country did not afford natural ballast. Its expense slightly exceeds that of the ordinary ballast; the blue clay burnt in kilns was found to answer the purpose best, but it does not appear to form a successful substitute for gravel.

The results of experiment show it to form a very imperfect drain.

The author states that he has always observed the quality of this ballast to suffer in proportion with the quantity of lime contained in its composition.—The paper is accompanied by four drawings, illustrating the construction of the permanent way.

ON THE APPLICATION OF WATER TO ANTHRACITE.

All persons who have been much accustomed to the use of anthracite for fuel seem to entertain an idea that the application of water has a beneficial effect. It is the invariable custom of the old inhabitants of the districts where no other fuel is used, to wet the coal before putting it on the fire. A wet paste of small culm, mixed with clay, makes a more lively and pleasant fire than small coal alone.

This must arise from the clay retaining a portion of the water until decomposed by the ignited carbon of the coal producing the gases, carbonic oxide and carburetted hydrogen. It has been suggested that the application of vapour of water to anthracite fires in steam boilers would supply the gaseous or volitile proerties of Bituminous coal; there is, however, much difficulty in the perfect developement of the principle, arising from the compact structure of the coal, and the close manner in which pieces of coal saem to adjust themselves in the fire. It is necessary that the coal be kept in an active state of combustion while the vapour is passing through, but so little passage being allowed through the fire, when the vapour of water is applied, it shuts off the supply of air, consequently the combustion is diminished. It requires both a very high temperature and a large quantity of pure air, with a full *quantum* of oxygen, to consume carburetted hydrogen—the most important of the two gases. Carbonic oxide burns at a very low temperature, and produces little heat. A quantity of flame may easily be produced by steam passing through an anthracite fire, but it is chiefly that of the latter gas, the former being volatilized without burning, and its powerful effect, consequently, lost. Besides the air necessary to keep up the combustion of the coal in the fire a large quantiy is necessary to consume the gases, and that too, at a high temperature. It appears impossible to to attain these results with a common draught.

The writer, after considerable experience, is decidedly of opinion that anthracite cannot be used with advantage in ordinary boilers without a blast. When a blast is used, although it may be difficult yet it is not impossible to devise a method of producing the full effect from the application of water to an anthracite fire; it is a subject of vast importance, and well worthy the attention of young mechanics and engineers—a fine field for the exercise of their ingenuity. It is quite certain that some anthracite contains ninety-five per cent. of pure carbon, and were it possible to render the entire effect of this available, certain portions of it converted into volatile inflammable matter by its union with the elements of water, and steadily and continuously applied to the tube or flues of a boiler without loss anthracite might be considered as a species of concentrated fuel—an invention of incalculable value for steamers going upon long voyages. When anthracite is used for blacksmith work, there is abundance of heat, but a large quantity of cinder is formed; this cinder has generally been considered as a mere oxide of iron, but it certainly contains carbon. It is the same cinder which is produced in large quantities in the refining process of iron works. Possibly oxygen and carbon, in the proportions to form carbonic oxide, are combined with the iron. A minute quantity of water running into a blacksmiths fire, when using anthracite, would remedy this —the presence of hydrogen preventing, in a great measure, the formation of the cinder. It is an axiom in the north of England, that a good gas coal is a good smith's coal, and *vice versa*. It will be quite impossible to manufacture malleable or bar iron of good quality, using anthracite for fuel, without the application of the va-

pour of water. This is a subject of the deepest interest to parties embarking in iron-works, where anthracite must be used for fuel. A patent for producing gas, by passing steam through a retort charged with anthracite, has been taken out by E. O. Manby, Esq., C. E., of Swansea—a gentleman possessing a thorough local knowledge of the anthracite district of South Wales, and who has had the best opportunities of judgeing of the powers and capabilities of the coal. He produces gas of great illuminating power rapidly and abundantly, which requires no purification. It seems likely that the distinguishing feature in the difference of the several varieties of coal depends upon the presence of the elements of water, either entire or in varying proportions, that are combined with the carbon—anthracite being quite free from them. It is a fair speculation to imagine that the anthracite veins of coal at some period possessed bituminous properties, but that being more immediately acted upon by volcanic commotion, all volatile matter was expelled, while extraordinary pressure being applied left the coal a solid compressed mass of carbon, constituting the peculiar characteristic of anthracite.—*Mining Journal.*

ACADEMY OF SCIENCES.

Feb. 1.—M. Ebelman read a memoir on the nature of the *various vapours developed in smelting furnaces*, as observed at different altitudes within the furnace. The object of ruch researches was to determine the degree of heat at various points, and to devise means for the improved regulations of the fires. He has arrived at the following results.—1. The gaseous vapours, on coming out of a furnace heated by charcoal or wood, contain watery vapour, corbonic acid, and oxides of hydrogen and azote, but no carbonated hydrogen. At 6 or 8 feet below the mouth of the furnace the watery vapour is not found, and the proportion of oxide of carbon increases, while those of hydrogen and carbonic acid diminish, according as the observations are made lower and lower down in the furnace. 2. When coal is used jointly with wood for heating the furnace, the carbonization of the vapours takes place in an internal zone, and the water is expelled from the metal at a very low altitude. He found that the proportion of gas, which traverses a certain zone of the furnace per minute, is greater according as it is further from the bottom of the furnace.

The Minister of Commerce communicated to the Academy some observations from the Industrial Society of Mulhausen on the importance of adopting an unit of measure for the force of machines, considered not only in the power exerted, but in the time required. The Society observed, that the usual estimation of horse power was not uniform, and proposed that the unit of France should be the force required to raise one kilogramme to the height of a metre in a second. To this unit they proposed that the name of *dyne* from the Greek root, signifying "moving force," should be applied, and then that it should be compounded with Greek and Latin words, in the

same way as the metre, the gramme, etc. Thus the *kilodyne* would signify a thousand times this unit, and the *millidyne* would signify the thousandth part of the same unit.

M. Arago read a communication from M. Rusiger a German geologist, on certain geometrical observations, made in order to ascertain the relative altitudes of the Dead Sea, in Palestine and the Mediterranean.

It appeared not only that the surface of the Dead Sea was 219 toises, or about 1,314 feet lower then that of the Mediterranean, but also, from the geologicl phenomina observed on its shores, that the formation of the basin in which it lies was antecedent to all historic epochs. Hence the supposition that the sea was formed by the sinking of the plain on which the cities of the Pentapolis, (Sodom, Gomorrah, etc.) were situated, is incorrect. M. Arago added, that the observations of M. Berton, a French engineer, made the depression of the Dead Sea below the Mediterranean 419 metres, or 1374 English feet.

Atmospheric Railway.—The report on this subject of Sir F. Smith, R. E. and Professor Barlow, has been presented to Parliament. The summary of their opinions is thus given: "1. That we consider the principle of atmospheric propulsion to be established, and that the economy of working increases with the length and diameter of the tube. 2. That the expense of the formation of the line in cuttings, embankments, bridges, tunnels and rails, will be very little less than for equal lengths of a railway to be worked by locomotive engines, but that the total cost of the works will much greater, owing to the expense of providing and laying the atmospheric tube, and erecting the stationary engines. 3. That the expense of working a line on this principle, on which trains are frequently passing, will be less than working by locomotive engines and that the saving thus effected will, in some cases, more than compensate for the additional outlay; but it will be the reverse on lines of unfrequent trains. However; there are many items of expense of which we have no knowledge and can form no opinion, such as the wear and tare of pistons, valves, etc.; on these, further experience is needed. 4. That with proper means of disengaging the train from the piston in cases of emergency, we consider this principle as regards safety equal to that appertaining to rope machinery. There appear, however, some practical difficulties in regard to junctions, crossings, sidings and stoppages at road stations, which may make this system of less general application."

Brick-making, etc.—A discovery has been made by Mr. R. Prosser of Birmingham, which bids fair to be attended with important results to the interests of architecture. The novelty of Mr. Prosser's process consists in the clay being dried, ground to powder, and submitted to pressure in metallic moulds until the particles cohere together. As there is no water in combination with the clay, no drying process is necessary; consequently the articles made by this method are ready to be fired or burned as soon as they leave the

machine. Owing to the great pressure required to cause the particles of clay to cohere together, the articles made by this press have greater density than those made in the ordinary way; they are also less porous, and not subject to decay in wet or frost. In addition to these advantages, any architectural device may be impressed upon the clay, which. when burnt, will retain all the sharpness of the original, however elaborately finished. By this process bricks may be made in all weathers, and with greater economy than by any other plan known at present. The brick-press is worked by hydraulic pumps, giving about 300 tons pressure, thus producing the adhesion and cohesion. The machine delivers the brick (four at a time in the present machine) ready at that instant for the kiln, requiring no exposure to the atmosphere to dry. The whole operation, from the time of putting the powdered clay into the machine to the delivery of the brick,. occupies about half a minute. Machinery might readily be constructed to produce bricks fifty a minute.—*Daily Paper,*

Flour Transportation by Railroad.—The following note to the directors of the Western railroad, show the result of actual experiment in the transportation of flour from the west by railroad. —*Troy Whig.*

No. 23, Long Wharf,
Boston, May 25, 1842.

Gentlemen: Having received several parcels of flour over the Western railroad, it gives us much pleasure to state that they came in excellent order, without waste, and with great despatch.

In our judgement, the road answers the expectations of its warmest friends, so far as the transportation of flour is concerned. At the present price of freight, 32 cents per barrel for flour, the cost by railroad is only *one cent* per barrel more than the freight by packets, thus:

Freight by packet from Albany, - - -	25	cents.
Insurance at $6 per barrel half per cent, - -	3	"
Wharfage in Boston, - - - - -	2	"
Interes on $6 per barrel, allowing a passage of 10 days,	1	"
	31	per bbl.

You will doubtless find the receipts of flour over the road increase weekly, and when the new crop of wheat (which is very large) comes to market, you will find your warehouse, large as it is, barely sufficient to accomodate the immense quantity of flour which will seek a market in your city.

We are very respectfully, yours,
E. Williams & Co.

Signor C. Ghega, the Austrian Engineer.—The distinguished and accomplished Signor Ghega, so well known in Europe as the founder and constructer of the railroads of Germany and Austria, and who was dispatched to this country by the Emperor

to examine and report upon American improvements in locomotion, nearly accomplished his extensive tour through the United States, and has expressed himself in the highest terms of admiration of our astonishing advancement in the art. His judgement fully confirms the claims made by our engineers to a superiority over the British in locomotive machinery. Some of our engines, in which the latest improvements have been introduced, he has pronounced immeasurably in advance of all others in the world.

Signor Ghega has inspected all the principal lines of railroad, and has been industrious in Philadelphia, Baltimore, Washington, New York, Boston and Albany, in making plans and calculations with which he is about to return richly freighted to Europe. He is now completing his survey of Lake Erie, and will sail in time to meet the Archduke Frederic at Venice before that Prince embarks on his promised voyage to this renowned republic. This young Prince, who is described as a highly amiable and accomplished gentleman, would doubtless be received here with all the courtesy and attention that was paid to the Prince de Joinville, and is expected to arrive here in the Austrian frigate Venus in the beginning of September. And we are as gratifind to know, as Signor Ghega is warm in acknowledgeing, that he has every where been received with as much kindness, hospitality and respect as could have been shown to royalty itself; and this intercourse of eminent foreigners with our country, cannot fail to extead our good name and fame throught the civilized world, and greatly redound to our commercial and intellectual advantage.

German Railways.—The Prussian State Gazette publishes a long article on the railways of Germany, the result of which is the division of all the lines of railway into the following:

Miles finished - -	175⅓	which have cost	$28,940,000
Miles in course of construction - -	166⅔	which will cost	43,357,000
Miles determined on -	124¼	estimated at	27,240,000
Miles projected - -	363	proximate estimate	30,586,000
Miles, lines of junction -	193	" "	42,846,000
Total number of miles, -	1,022	Cost - -	$172,969,000

The Leipsic Gazette, on the other hand, announces that the Austrian Government has decided on authorizing the construction of a railway between Vienna and Dresden, by the valley of the Elbe. It is expected that all possible favor will be conceded to the plan, and that there will ever, be the guaranty of an interest of 4 per cent.

Steam Power as a Bond of Union.—We see the results of the emplyment of this element as a means of consolidation in our own country; composed as it is of so large an extent of territory, filled with such a mass of discordant materials, and so many conflicting interests. Steam power binds the whole together in a compact mass; and but for the application of this power, the union of

the twenty-six States would not last twenty years. And so it is with the consolidation of the energies of the British Empire. The political union depends upon the social union; the intermingling frequently and at the most remote points of the social, political, and commercial elements of the whole nation. And nothing which can be brought to bear upon the energies of a nation, binds them so thoroughly together as the application of steam power, and its elements, to every ramification of the social and political system.

Central Railroad.—We are pleased to learn from a gentleman who visited most of the work beyond Oocanee, a few days since, that the contractors are pushing on with their work, with all possible speed. It seems that the suspension of the Railroad Bank has not operated so seriously against the interest of the Company, as its enemies had hoped. The public knows the cause of this suspension. No mysterious circumstances are connected with it. No schemes of speculation brought it about. The available means have been expended in constructing a railroad connecting our princpal seaport with the very heart of the state, thus bringing to our doors a convenient market for our produce, and where we may purchase our groceries on better terms than heretofore. The people in view of these things will certainly do all in their power to sustain the bank. We are truly glad that the contractors are pressing on with the work with all possible speed, evincing thereby, their confidence in the bonds of the company.

Locomotive and Train stopped by Worms.—The Charleston Patriot contains the following remarkable story.

On the completion, a few days since, of the railway, on the Tressel and Bridge over the Congaree Swamp, and river, a general migration of the Caterpillars of richland, took place towards the St. Mathews shore. An army of worms, occupying in solid column, the iron rail for upwards of one mile, presented, as was supposed, but a feeble barrier to the power of steam. A locomotive with a full train of cars loaded with iron, and moving at a speed of from ten to twelve miles an hour, was arrested, notwithstanding at midway in the swamp by these insects, and through the agency of sand alone, freely destributed on the drawing wheet, was it able to overcome them. It was a sanguinary victory in which millions were crushed to death; though the caterpillars maintained their ground and enjoyed a triumph in resting for a brief period, even the power of the locomotive.

Among the strange craft that navigate the Ohio, is a floating glass manufactory. A large flat boat is filled up with a furnace, tempering oven, and the usual apparatus proper for such an establishment. It is in full blaze every night, melting glass ware, which is retailed all along shore, as the establishment floats down stream. It hails from Pittsburg, and is owned by Ross & Co.